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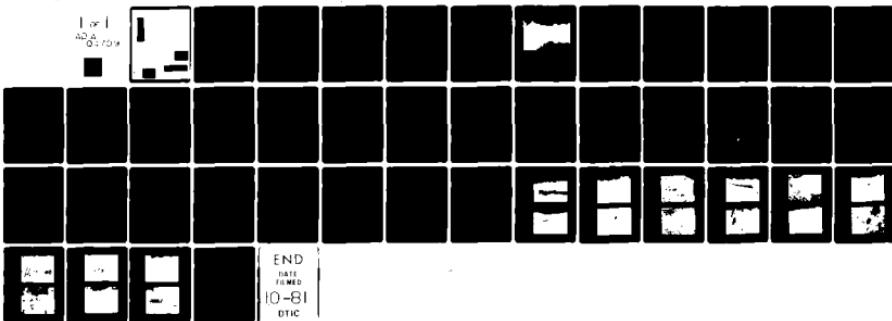
ARMY ENGINEER DISTRICT ST LOUIS MO  
NATIONAL DAM SAFETY PROGRAM, SHERMAN LAKE DAM (MO 30839), MISSI--ETC(U)  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

SHERMAN LAKE DAM  
BOLLINGER COUNTY, MISSOURI  
MISSOURI INVENTORY NO. 30839

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS  
FOR: GOVERNOR OF MISSOURI

AUGUST 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Sherman Lake Dam
State Located	Missouri
County Located	Bollinger County
Stream	Castor River
Date of Inspection	23 May 1979

A 23

The Sherman Lake Dam was inspected by an interdisciplinary team of engineers from the Memphis District, U. S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten the life and property of approximately 5 families downstream of the dam and cause appreciable damage to Highway 51 bridge located approximately one mile downstream.

The inspection and evaluation indicate that the spillway does not meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to PMF. However, considering the high-hazard potential to life and property of approximately five families downstream of the dam, the PMF is considered the appropriate spillway design flood. The PMF is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The spillways for Sherman Lake will only pass 15 percent of the PMF before the dam embankment is overtopped. Because the spillways will not pass one-half of the PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency". Also the spillways will not pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

Other deficiencies visually observed by the inspection team were trees and bushes on the upstream embankment slope and at the right abutment emergency spillway; erosion gullies on the downstream embankment slope; and seepage. Another deficiency found was the lack of seepage and stability analysis records.

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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APPROVED BY:

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Colonel, CE, District Engineer

19 SEP 1979

Date

19 SEP 1979

Date



**Overview of Lake and Dam**

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
SHERMAN LAKE DAM - ID NO. 30839

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## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer for the St. Louis District, Corps of Engineers, directed that a safety inspection of the Sherman Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

### 1.2 DESCRIPTION OF PROJECT

#### a. Description of Dam and Appurtenances.

(1) The dam is an earth embankment built in a narrow valley in the uplands which border the Mississippi Embayment. Topography adjacent to the valley is rolling to steep. Soils in the area are formed of red sandy clays with fragments of dolomite and chert. Topography in the vicinity of the dam is shown on Plate 2.

(2) The primary means of discharge is two emergency spillways cut in the right and left abutments.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the southwestern portion of Bollinger County, Missouri, as shown on Plate 1. The lake formed by the dam as shown on Plate 2 is located on the Zalma, Missouri Quadrangle sheet in Section 31; Township 29 North; Range 9 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c above. Based on these criteria, this dam is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in a High Hazard Classification.

e. Ownership. The dam is owned by Mr. Milton Nitsch, Route 3, Highway 61 East, Jackson, Missouri 63755.

f. Purpose of Dam. The dam forms a 12-acre recreational lake.

g. Design and Construction History. The dam was constructed around 1964 by the previous owner, Bill Sherman, of Sherman Brothers Excavation Company. There were no design plans. Borrow material for the construction of the dam consisted of the native red clay which was taken from the lake area and from the surrounding hills. The dam reportedly has a 16 foot wide core trench that extends approximately 14 feet down to rock.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relative stable water surface elevation. The dam reportedly was overtopped in the early 1970's during a period of very heavy rainfall.

### 1.3 PERTINENT DATA

a. Drainage Area. 551 acres.

b. Discharge at Damsite. (1) Discharge can take place through two emergency spillways cut in the right and left abutments.

(2) Estimated experienced maximum flood at damsite - unknown.

c. Elevation. (Feet above M.S.L.)

(1) Observed Pool - 396.10

(2) Normal Pool - 395.9

(3) Spillway Crest - Left Abutment - 396.1  
Right Abutment - 395.9

(4) Maximum Experienced Pool - unknown (Dam reportedly overtopped, early 1970's).

(5) Top of Dam - 399.2

(6) Maximum Pool (PMF) - 401.4

- (7) Invert of discharge pipe at stilling basin - N/A
- (8) Maximum tailwater - unknown
- d. Reservoir. Length of maximum pool - 2000± feet
- e. Storage (Acre-feet).
  - (1) Observed Pool - 147
  - (2) Normal Pool - 144
  - (3) Spillway Crest - Left Abutment - 147  
Right Abutment - 144
  - (4) Maximum Experienced Pool - unknown
  - (5) Top of Dam - 207
  - (6) Maximum Pool (PMF) - 257
- f. Reservoir Surface (Acres).
  - (1) Observed Pool - 18.81
  - (2) Normal Pool - 18.61
  - (3) Spillway Crest - Left Abutment - 18.81  
Right Abutment - 18.61
  - (4) Maximum Experienced Pool - unknown
  - (5) Top of Dam - 21.91
  - (6) Maximum Pool (PMF) - 24.47
- g. Dam.
  - (1) Type - earth embankment.
  - (2) Length - 440 feet.
  - (3) Height - 25 feet maximum.
  - (4) Top width - 15 feet.

(5) Side slopes -

(a) Downstream - 1V on 3.5H (Average).

(b) Upstream - 1V on 3.0H (Average).

(6) Zoning - unknown.

(7) Impervious core - core trench reportedly 14 feet deep and 16 feet wide.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

h. Diversion and Regulating Tunnel. None.

i. Primary Discharge System. None.

j. Emergency Spillway.

(1) Type - Uncontrolled earthen trapezoidal.

(2) Width of weir - Left Abutment - 25' (Average).  
Right Abutment - 45' (Average).

(3) Length of weir - N/A.

(4) Crest elevation - Left Abutment - 396.1 feet m.s.l.  
Right Abutment - 395.9 feet m.s.l.

k. Regulating Outlet. None.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No design data exists.

### 2.2 CONSTRUCTION

The dam was constructed around 1964 by the previous owner, Bill Sherman, of Sherman Brothers Excavating Company. The dam was constructed from the native red clays taken from the lake area and the surrounding hills. The dam reportedly has a 16 foot wide core trench which extends approximately 14 feet down to rock.

### 2.3 OPERATION

There are no structures or appurtenances associated with the dam other than the two uncontrolled spillways located at the right and left abutments.

### 2.4 EVALUATION

a. Availability. The only engineering data readily available are the personal recollections of the present and previous owners.

b. Adequacy. The field and visual inspections presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General. Visual inspection of Sherman Lake Dam was performed on 23 May 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a geologist, hydraulic engineer, and soils engineer. Specific observations are discussed below.

b. Project Geology. The dam is located on the foothills of the Salem Plateau which is part of the Ozark Plateau system. The dam is situated at the edge of the uplands where the creek flows out onto the alluvium of the Castor River. The slopes around the lake are gentle and the possibility of a sudden landslide into the lake is very remote. As the dam is reportedly to have been constructed from local materials it probably consists of red sandy clay with dolomite and chert fragments intermixed. A cherty dolomite is exposed in the bottom of both spillways. The dolomite is badly weathered and fractured where it is exposed. The soil consists of rock fragments and a sandy red clay which is the product of the weathering of the dolomitic bedrock. The cherty dolomite is part of the Lower Ordovician and is probably the Jefferson City or Cotter formation. The Dolomite is light gray to tan containing chert nodules. The chert is highly resistant and forms a large part of the fragments found in the residuum. The Jefferson City formation is underlain by the Roubidoux formation which is composed of sandstone, chert and dolomite. The dam is located in a Seismic Zone 2.

c. Dam. Based on the cross-section presented on Plate 5 the dam has an average upstream embankment slope of 1V on 3H and an average downstream slope of 1V on 3.5 H. The crown width of the dam is 15 feet. The visual inspection indicates no evidence of any undue settlement, cracking or sliding of the dam. No animal burrows were observed in the dam.

Trees and bushes are growing along the entire length of the upstream face of the dam (see Photo 4). The upstream embankment has no erosion protection and some wavewash and erosion has occurred intermittently along the upstream face (see Photo 5). Several erosion gullies were noted on the downstream side of the crown and on the downstream slopes at baseline stations 4+08 and 4+30 (see Photos 6 and 8). At station 5+35 there is a large wash area near the valley slope at the right abutment (see Photo 9).

A large wet area was observed at the downstream toe of the dam from baseline 3+00<sup>+</sup> to station 4+50<sup>+</sup> (see Plate 6). The area was soft and spongy and was covered with trees, cattails, and other vegetation (see Photos 10 and 11). Crawfish holes were also observed in the area. Portions of the area appeared to be just trapped water, but evidence of seepage was apparent at several locations (see Photos 12 and 13). The majority of the seepage seemed to be concentrated in an area from stations 4+00 to 4+50. Seepage flows were estimated to be 50 gpm. No material was observed being piped by the seepage flows.

d. Appurtenant Structures. Two uncontrolled spillways, one located at each abutment, provide the only means of discharge from the lake (see Photos 14 - 17). The earth spillways consist of a sandy red clay with rock fragments. A cherty dolomite is exposed in the bottom of both spillways.

Trees and vegetation were observed at the inflow area of the spillway at the right abutment (see Photo 14) creating an obstruction to flow. The spillway at the left abutment is free from obstruction.

e. Reservoir Area. No wave wash, excessive erosion, or slides were observed along the shore of the reservoir.

f. Downstream Channel. The downstream channels for both spillways are in relatively good condition and are not overgrown with vegetation (see Photos 15 and 17).

### 3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure. Visually observed seepage, trees on the upstream embankment and at the inflow of the right abutment spillway, and erosion gullies and wash areas on the downstream slope are deficiencies which, left uncontrolled or uncorrected, could lead to the development of potential problems.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The two emergency spillways are uncontrolled; therefore, no regulating procedures exist for these structures.

### 4.2 MAINTENANCE OF DAM

Little maintenance is apparent as evidenced by the wave wash areas on the upstream slopes and erosion gullies on the downstream slope. Brush and small trees are growing on the upstream face of the dam and at the inflow area of the right abutment spillway.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist. The two uncontrolled spillways provide the only means of discharge from the lake.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

### 4.5 EVALUATION

If the trees and brush on the upstream slope and at the right abutment spillway, the wavewash on the upstream embankment, and the erosion gullies on the downstream slope are allowed to continue, potential problems could develop.

## SECTION 5 - HYDRAULIC/ HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

- a. Design Data. No design data are available for evaluation.
- b. Experience Data. The drainage area and lake surface area are developed from USGS Zalma, Missouri Quadrangle. The spillway and dam layout are from surveys made during the inspection.
- c. Visual Observations.
  - (1) The principal means of discharge is from two uncontrolled earthen spillways located at the right and left abutments.
  - (2) Trees are growing in the inflow area of the right abutment spillway.
- d. Overtopping Potential. The spillway will pass 15 percent of the Probable Maximum Flood (PMF) at a discharge of 620 cfs without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be discharged from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF will overtop the embankment for a period of 6 hours at a depth of 2.2 feet with a discharge of 5400 cfs. The one-half PMF will overtop the embankment for a period of 4 hours at a depth of 1.2 feet with a discharge of 2600 cfs. The 100-year frequency will also overtop the embankment. For its size and hazard category, this dam is required by the guideline to pass from one-half PMF to PMF. However, considering the high hazard potential to life and property of approximately 5 families downstream of the dam, the PMF is considered to be the appropriate spillway design flood. Because the spillways will not pass one-half of the PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency." The data utilized in the preparation of these estimates was various Federal reports, data from field inspection and survey, and output from COE program, HEC-1, Dam Safety Version.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the dam and appurtenant structures are discussed and evaluated in SECTIONS 3 and 5.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operation Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes exist which will affect the structural stability of the dam.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between Seismic Zones 2 and 3. Since this dam is located in Seismic Zone 2 and the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety. Several items were noted during the visual inspection which should be corrected or controlled. These items are trees and brush on the upstream embankment face and right abutment spillway inlet area; wavewash and erosion on the upstream embankment; erosion gullies and wash areas on the downstream embankment slopes; and observed seepage. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. Also these analyses should be utilized to detail the corrective actions called for in paragraph 7.2. The Probable Maximum Flood (the spillway design flood) and one-half of the Probable Maximum Flood will both overtop the dam. Because the spillways will not pass one-half of the PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency".

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2 a should be pursued on a high-priority basis. The stability and seepage analyses should be given priority by the owner and accomplished without delay in order to determine if corrective measures are necessary. If the safety deficiencies listed in paragraph 7.1 a. are not corrected in a timely manner, they could lead to the development of potential problems.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between Seismic Zones 2 and 3. Since this dam is located in Siesmic Zone 2 and the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

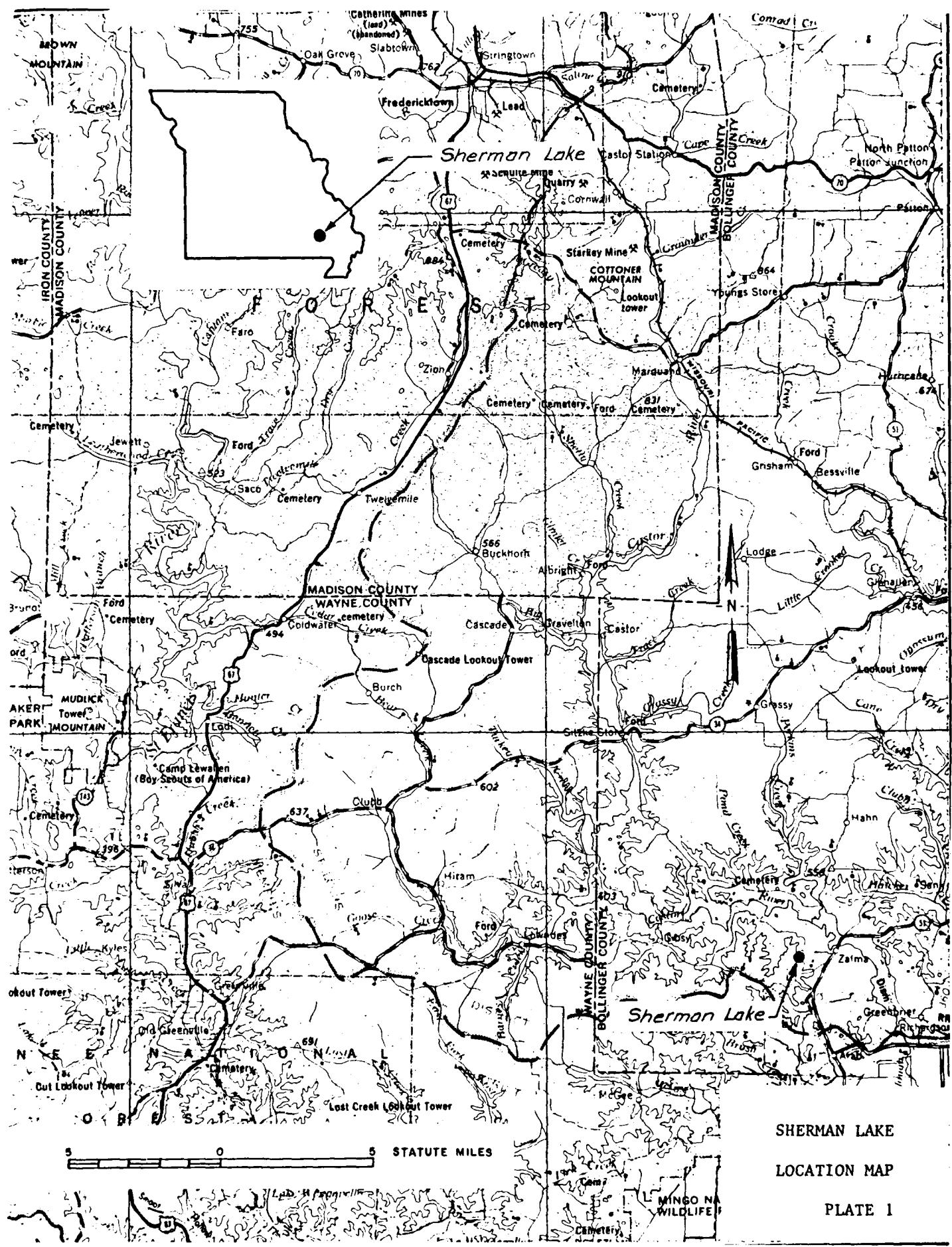
## 7.2 REMEDIAL MEASURES

a. Alternatives. Spillway size and/or height of dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

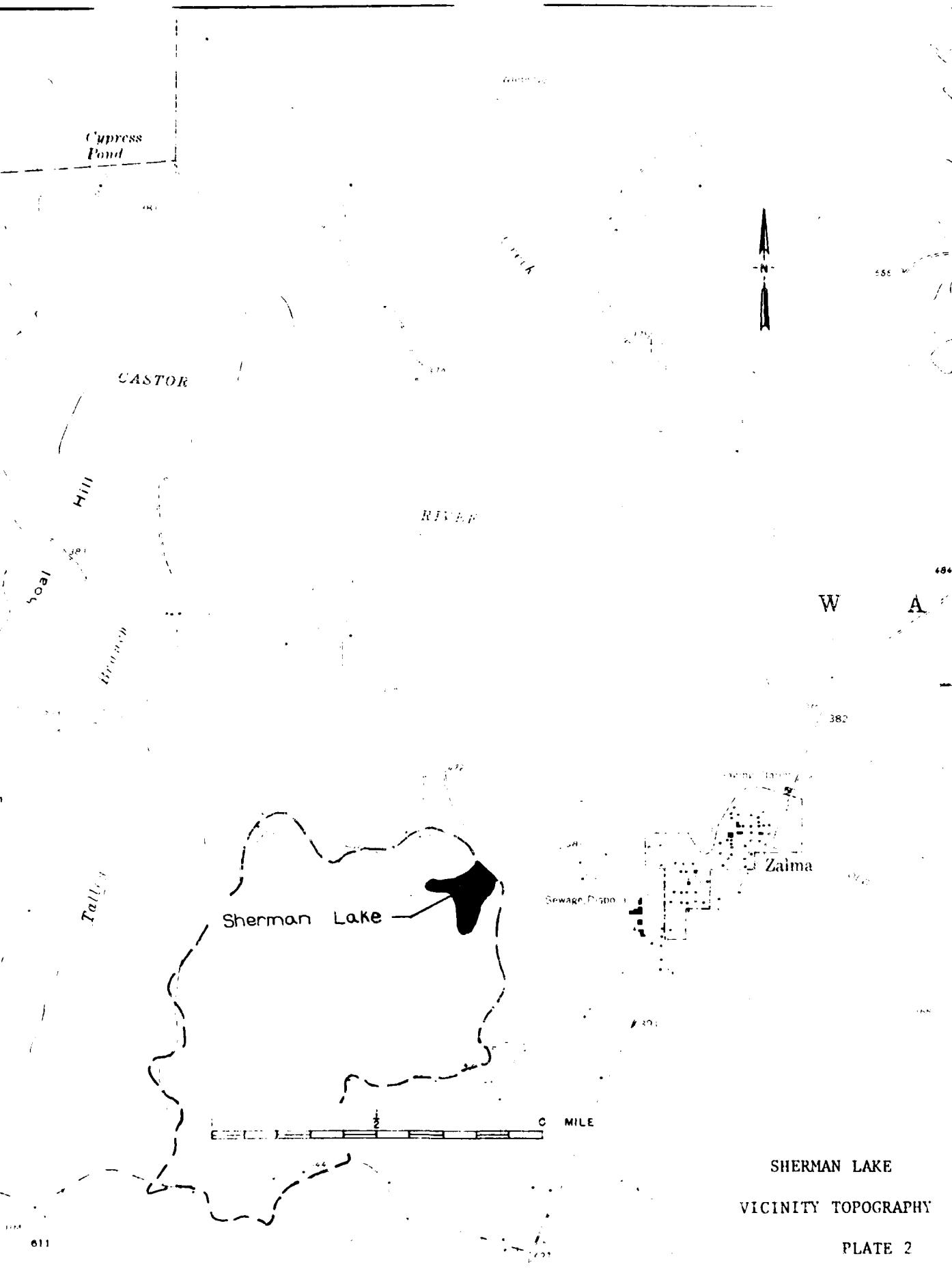
b. Perform seepage and stability analyses to assess the safety concerns raised by the seepage present at the downstream toe of the dam. Use the results of these analyses to design appropriate corrective measures.

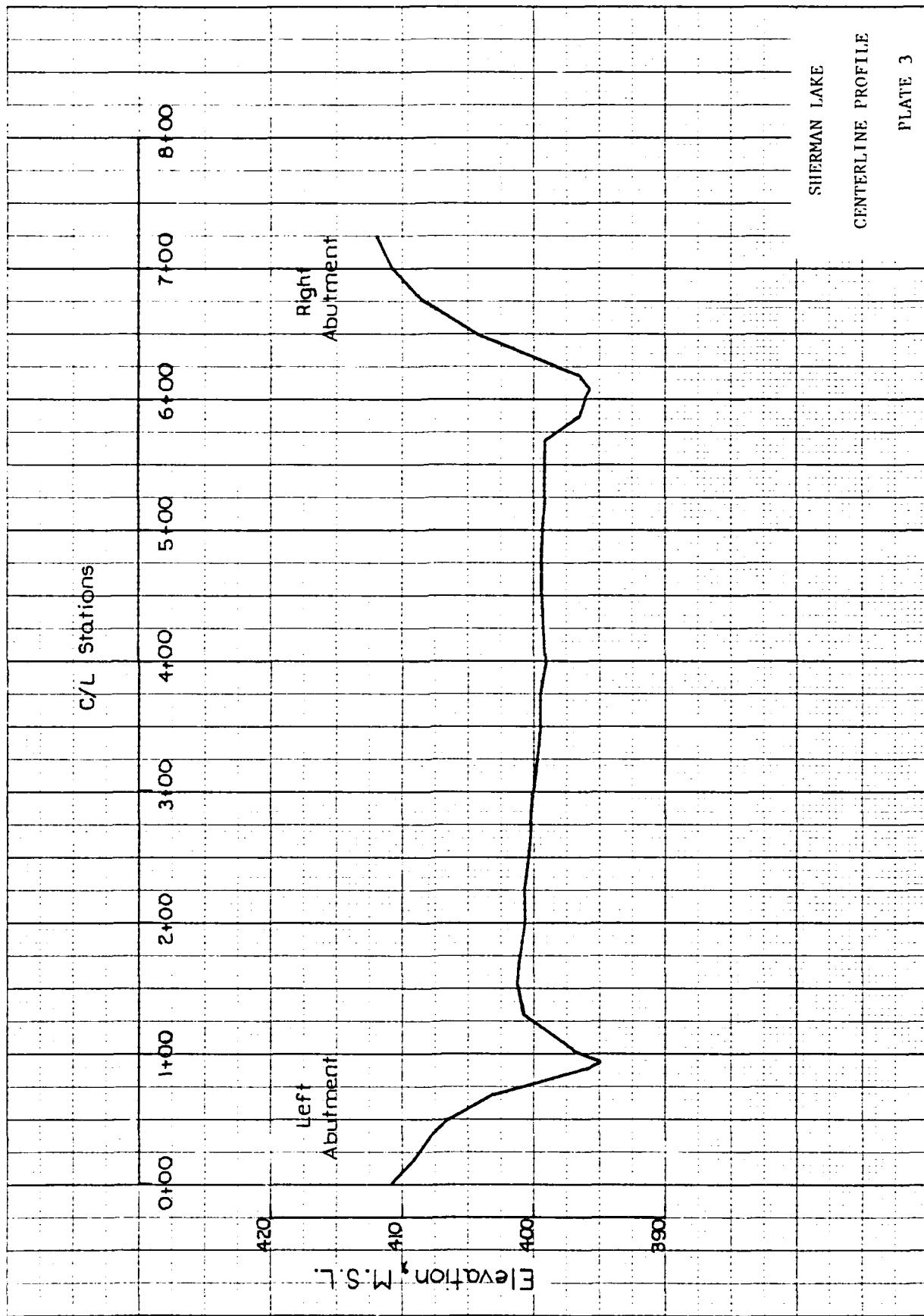
c. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

- (1) Remove trees and brush on upstream embankment slope and at right abutment spillway inlet area. Care should be taken during removal not to destroy the existing conditions of the upstream embankment and spillway area.
- (2) Repair wave wash and erosion areas on upstream embankment slope and provide some type of erosion protection to prevent future occurrences.
- (3) Repair the downstream slope where gullies and wash areas have formed.
- (4) The downstream slope and toe should be closely monitored for seepage and erosion. If seepage quantities and/or erosion observed during monitoring indicate increases or signs of material being piped from the embankment, immediate action should be taken to rectify these conditions.
- (5) A detailed inspection of the dam should be made at least every 5 years by an engineer experienced in design and construction of dams.



SHERMAN LAKE  
LOCATION MAP  
PLATE 1

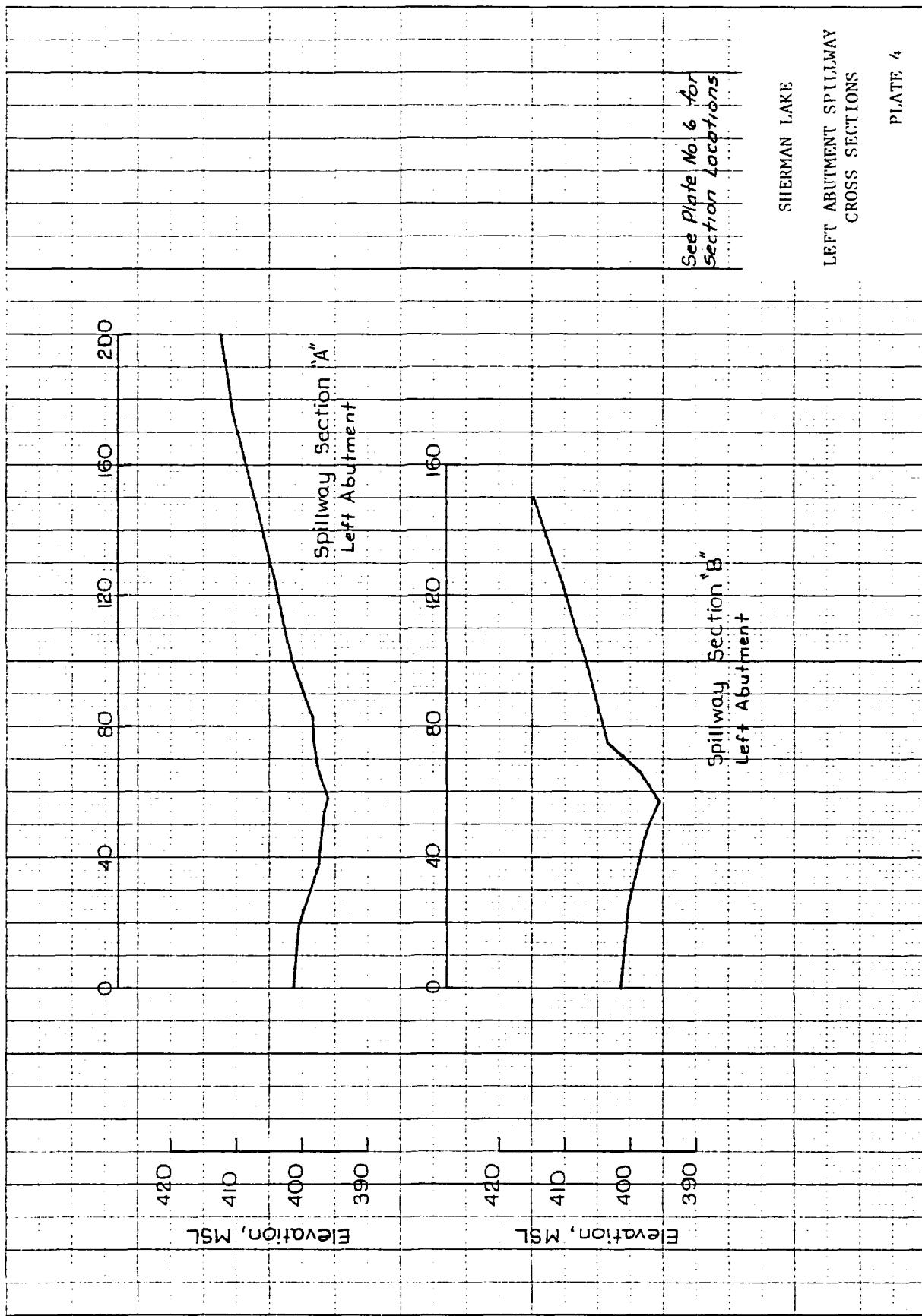


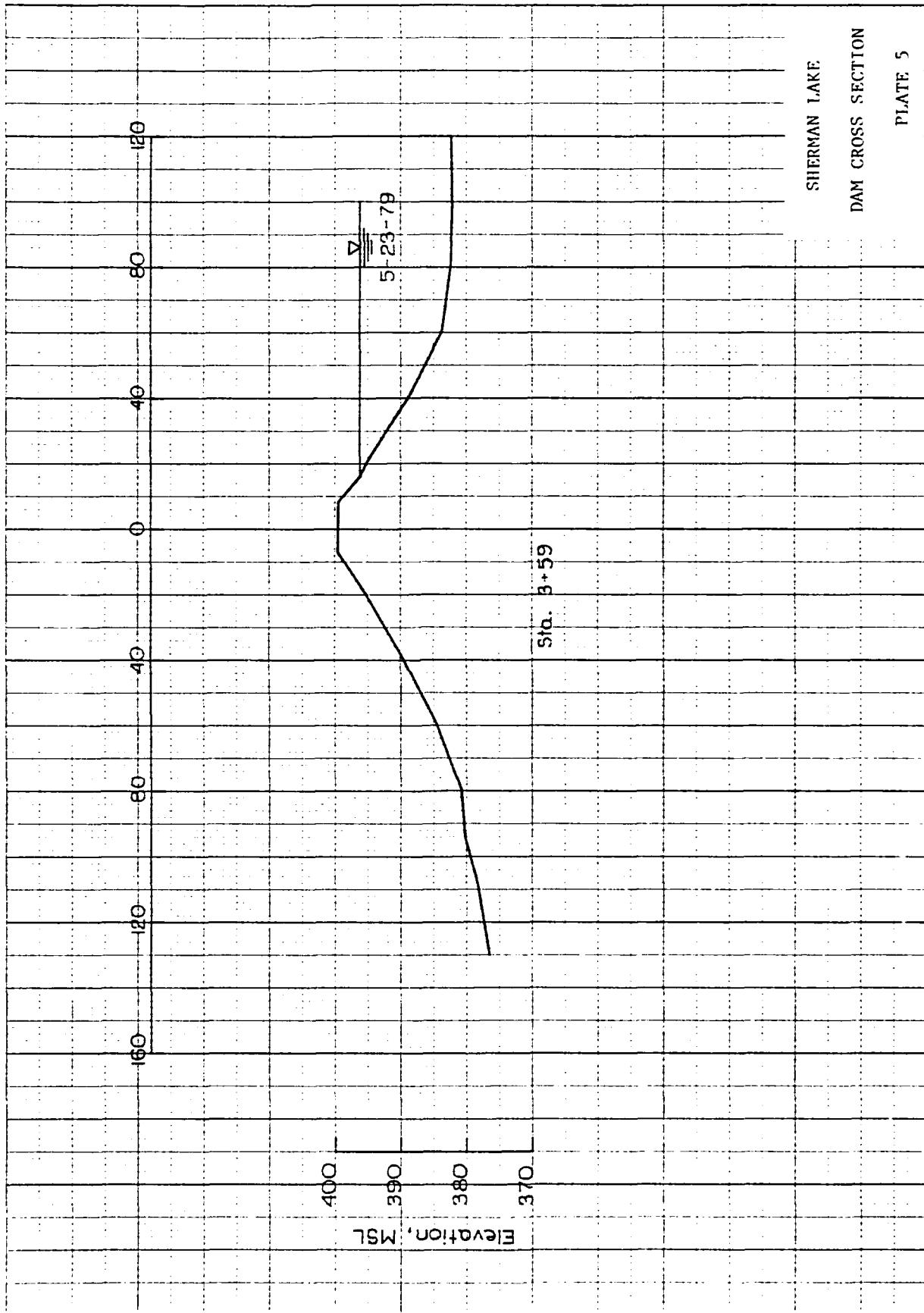


SHERMAN LAKE

CENTERLINE PROFILE

PLATE 3





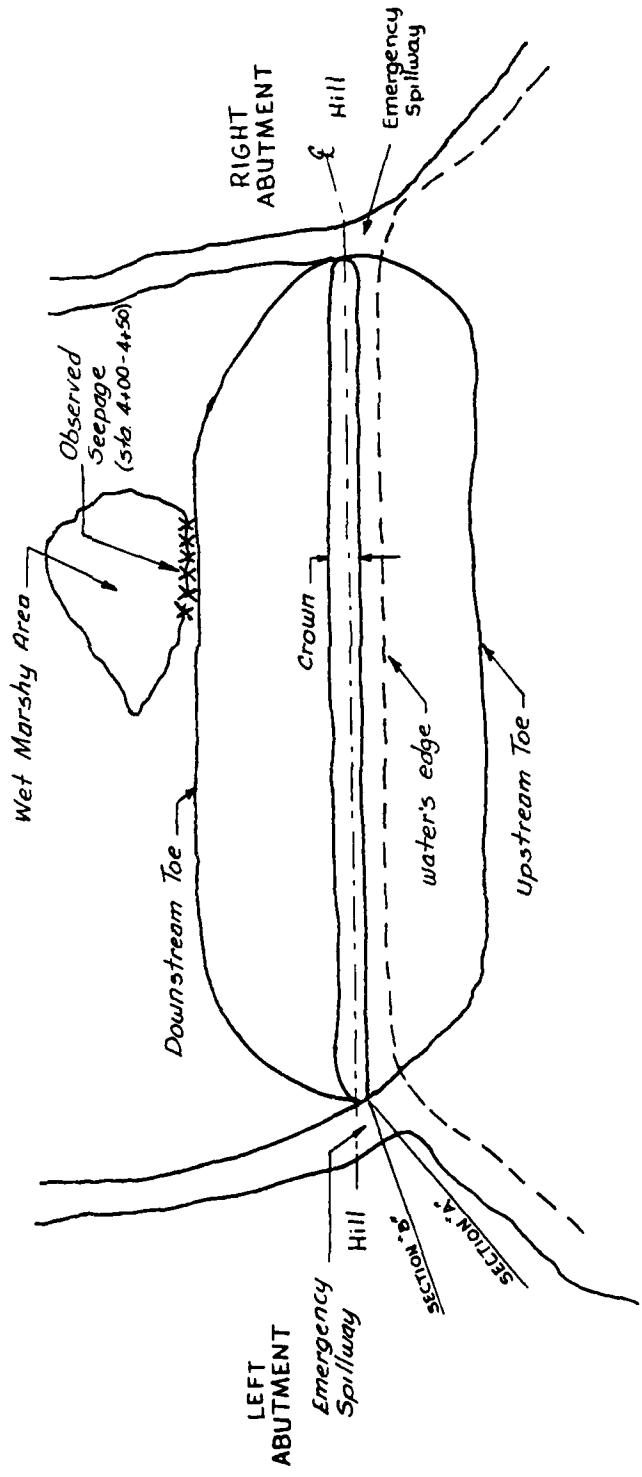
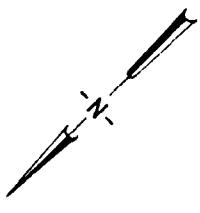
SHERMAN LAKE

DAM CROSS SECTION

PLATE 5

0+00 0+50 1+00 1+50 2+00 2+50 3+00 3+50 4+00 4+50 5+00 5+50 6+00 6+50 7+00 7+50 8+00

Scale : 1" = 100'



SHERMAN LAKE  
DAM PLAN VIEW  
PLATE 6

## APPENDIX A HYDROLOGY AND HYDRAULIC

1. Narrative. The methods and sources of data were primarily those suggested by the Hydraulics Branch, St. Louis District, Corps of Engineers. Specific references and methods will be discussed below. A field inspection and survey was made to determine the outlet structures and the topographic characteristics of the dam. HEC-1, Dam Safety Version was used in conjunction with appropriate input parameters to compute inflow hydrographs, determine storage, and route through the structure.

a. Rainfall. The PMF was developed using Hydrometeorological Report No. 33. The "Hop Brook" reduction factor was not used to adjust the rainfall for this study. The distribution of rainfall was developed using the criteria as described by EM 1110-2-1411 (Standard Project Storm).

PMF Rainfall	27 in.
PMF Percentages	6 hr. 102
	12 hr. 120
	24 hr. 130
	48 hr. 140

b. Unit Hydrograph Coefficients. The unit hydrograph for the drainage basin was developed using the Snyder Method as outlined in HEC-1, Dam Safety Version. Two methods of determining time of concentration were used, namely the Snyder's Method and Kirpich Method. The variable used for the appropriate method are listed below:

Snyder's:

$$t_p = C_t (L L_{cg})^{0.3} ; L L_{cg} \text{ in miles}$$

$$L = 8600 \text{ feet} = 1.63 \text{ miles}$$

$$L_{cg} = 4140 \text{ feet} = 0.78 \text{ miles}$$

$$\text{Stream Slope} = 84 \text{ ft/mile} = .016 \text{ ft/ft}$$

$$C_t = .6$$

$$t_p = .65 \text{ hr.}$$

$$t_c = .81 \text{ hr.}$$

Kirpich

$$t_c = .00013 \left( \frac{L \text{ ft}}{\sqrt{\text{Slope, ft/ft}}} \right)^{.77}$$

$$t_c = .69 \text{ hr.}$$

Where  $L$  = length of the main stream channel from the outlet to the divide

$L_{cg}$  = length along the main channel to a point opposite the watershed centroid

$C_t$  = coefficient used in Snyder's Method

$t_p$  = time to peak (hours)

$t_c$  = time of concentration (hours)

Consequently, since the time of concentrations agreed so closely, a value for the  $t_p$  was chosen to be .67 hr. or 40 minutes which necessitated developing a 10-minute unit hydrograph and applying only a 48 hr. rainfall to develop the inflow hydrographs.

The general soils map of Bollinger County indicates that Sherman Dam lies in an area where the soil is of the Menfro-Loring-Granada Association. This places the area in a Soil Group B. The primary soil cover consists of woods in a fair hydrologic condition which gives a value of CN of 78 for antecedent moisture condition III. Consequently, a value of  $C_p = .647$  was chosen as the runoff parameter to be used in Snyder's Method. Listed below are the remaining parameters necessary to develop the unit hydrograph of 10-minute duration.

$C_p = .647$   
Drainage Area = .861 sq. mi.

The unit hydrograph ordinates are found in the computer printout.

b. Loss Rates. A loss rate of .5 in. initially and .05 in./hr. was chosen based upon engineering experience.

c. Base Flow and Antecedent Flood Conditions. A base flow of 1 cfs was selected and the routing was started at the low point in the right abutment spillway crest of 395.9 m.s.l.

d. Hydrograph Routing. HEC-1, Dam Safety Version uses the single routing step of the "Modified Puls" method. Routing through the emergency spillways and over the embankment was accomplished using the non-level dam top option of the HEC-1, Dam Safety Version coupled with critical energy consideration of the flow.

e. Storage. The storage was calculated with the HEC-1, Dam Safety Version with input consisting of elevations and respective surface area which were determined using the USGS Zalma quadrangle.

ELKHORN WINDOMAINE PACKAGE (Type 1)  
DAM SAFETY VERSION  
LAST MODIFICATION: 24 FEB 79

NON-EMERGENCY DAM INSPECTION										
	DAM STATUS		SHIPPING DAW		=0		=0		=0	
1	A	A	0	10	-0	-0	-0	-0	-0	-0
2	A	A	300	0	-0	-0	-0	-0	-0	-0
3	H	H	5	1	-0	-0	-0	-0	-0	-0
4	H	H	1	0.15	0.18	0.25	0.10	0.15	0.9	1.0
5	H	H	1	1	1	1	1	1	1	1
6	H	H	1	1	1	1	1	1	1	1
7	H	H	1	0.15	0.18	0.25	0.10	0.15	0.9	1.0
8	H	H	1	1	1	1	1	1	1	1
9	H	H	1	1	1	1	1	1	1	1
10	H	H	1	0.602	0.602	0.609	0.100	0.100	0.9	1.0
11	P	P	1	27.0	102	120	130	140	150	160
12	P	P	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
13	X	X	1	0.67	0.67	0.67	0.67	0.67	0.67	0.67
14	X	X	1	1	1	1	1	1	1	1
15	X	X	1	1	1	1	1	1	1	1
16	X	X	1	1	1	1	1	1	1	1
17	X	X	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1	1	1	1
20	54	0	2,125	22,767	47,436	89,900	170,420	305,900	505,900	805,900
21	577	0	340	400	400	400	400	400	400	400
22	55	305.0	51	51	51	51	51	51	51	51
23	504.2	0	10	16	16	16	16	16	16	16
24	51	0	306.1	306.5	306.5	306.5	306.5	306.5	306.5	306.5
25	51	0	97	97	97	97	97	97	97	97

PERIODIC INSPECTION OF STRUCTURE AND WATER LEVEL MONITORING  
ELKHORN WINDOMAINE

FLUID HYDRAULIC PACKAGE (HF-11)  
DAM SAFETY VERSION  
JULY 1978  
LAST MODIFICATION 26 JUN 79

RUN DATE: 16 AUG 79  
TIME: 09.30.57

NON-EFFLUENT DAM INSPECTION

DAM SIGHTS

SHERMAN DAM

NO	NAME	MIN	MAX	THIN	WIDE	TP1	TP2	INSTANT
300		0	10	0	0	0	0	0
				0.15	0.15			
5		0	5	0	0			

MULTI-PILOT ANALYSIS IN RE-PERFECTED

NO	NAME	MIN	MAX	THIN	WIDE	TP1	TP2	INSTANT
10		0	10	0	0	0	0	0
				0.15	0.15			
20		0	20	0.25	0.30	0.35	0.50	1.00

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SIMULATED RAINFALL COMPUTATION

PHOTONIC MAXIMUM PRECIPITATION OVER THE DURATION

INSTANT	ICOMP	EFFC1	EFFC2	EFFC3	EFFC4	EFFC5	EFFC6	EFFC7	EFFC8	EFFC9	EFFC10	EFFC11	EFFC12	EFFC13	EFFC14	EFFC15	EFFC16	EFFC17	EFFC18	EFFC19	EFFC20	EFFC21	EFFC22	EFFC23	EFFC24	EFFC25	EFFC26	EFFC27	EFFC28	EFFC29	EFFC30	EFFC31	EFFC32	EFFC33	EFFC34	EFFC35	EFFC36	EFFC37	EFFC38	EFFC39	EFFC40	EFFC41	EFFC42	EFFC43	EFFC44	EFFC45	EFFC46	EFFC47	EFFC48	EFFC49	EFFC50	EFFC51	EFFC52	EFFC53	EFFC54	EFFC55	EFFC56	EFFC57	EFFC58	EFFC59	EFFC60	EFFC61	EFFC62	EFFC63	EFFC64	EFFC65	EFFC66	EFFC67	EFFC68	EFFC69	EFFC70	EFFC71	EFFC72	EFFC73	EFFC74	EFFC75	EFFC76	EFFC77	EFFC78	EFFC79	EFFC80	EFFC81	EFFC82	EFFC83	EFFC84	EFFC85	EFFC86	EFFC87	EFFC88	EFFC89	EFFC90	EFFC91	EFFC92	EFFC93	EFFC94	EFFC95	EFFC96	EFFC97	EFFC98	EFFC99	EFFC100	EFFC101	EFFC102	EFFC103	EFFC104	EFFC105	EFFC106	EFFC107	EFFC108	EFFC109	EFFC110	EFFC111	EFFC112	EFFC113	EFFC114	EFFC115	EFFC116	EFFC117	EFFC118	EFFC119	EFFC120	EFFC121	EFFC122	EFFC123	EFFC124	EFFC125	EFFC126	EFFC127	EFFC128	EFFC129	EFFC130	EFFC131	EFFC132	EFFC133	EFFC134	EFFC135	EFFC136	EFFC137	EFFC138	EFFC139	EFFC140	EFFC141	EFFC142	EFFC143	EFFC144	EFFC145	EFFC146	EFFC147	EFFC148	EFFC149	EFFC150	EFFC151	EFFC152	EFFC153	EFFC154	EFFC155	EFFC156	EFFC157	EFFC158	EFFC159	EFFC160	EFFC161	EFFC162	EFFC163	EFFC164	EFFC165	EFFC166	EFFC167	EFFC168	EFFC169	EFFC170	EFFC171	EFFC172	EFFC173	EFFC174	EFFC175	EFFC176	EFFC177	EFFC178	EFFC179	EFFC180	EFFC181	EFFC182	EFFC183	EFFC184	EFFC185	EFFC186	EFFC187	EFFC188	EFFC189	EFFC190	EFFC191	EFFC192	EFFC193	EFFC194	EFFC195	EFFC196	EFFC197	EFFC198	EFFC199	EFFC200	EFFC201	EFFC202	EFFC203	EFFC204	EFFC205	EFFC206	EFFC207	EFFC208	EFFC209	EFFC210	EFFC211	EFFC212	EFFC213	EFFC214	EFFC215	EFFC216	EFFC217	EFFC218	EFFC219	EFFC220	EFFC221	EFFC222	EFFC223	EFFC224	EFFC225	EFFC226	EFFC227	EFFC228	EFFC229	EFFC230	EFFC231	EFFC232	EFFC233	EFFC234	EFFC235	EFFC236	EFFC237	EFFC238	EFFC239	EFFC240	EFFC241	EFFC242	EFFC243	EFFC244	EFFC245	EFFC246	EFFC247	EFFC248	EFFC249	EFFC250	EFFC251	EFFC252	EFFC253	EFFC254	EFFC255	EFFC256	EFFC257	EFFC258	EFFC259	EFFC260	EFFC261	EFFC262	EFFC263	EFFC264	EFFC265	EFFC266	EFFC267	EFFC268	EFFC269	EFFC270	EFFC271	EFFC272	EFFC273	EFFC274	EFFC275	EFFC276	EFFC277	EFFC278	EFFC279	EFFC280	EFFC281	EFFC282	EFFC283	EFFC284	EFFC285	EFFC286	EFFC287	EFFC288	EFFC289	EFFC290	EFFC291	EFFC292	EFFC293	EFFC294	EFFC295	EFFC296	EFFC297	EFFC298	EFFC299	EFFC300	EFFC301	EFFC302	EFFC303	EFFC304	EFFC305	EFFC306	EFFC307	EFFC308	EFFC309	EFFC310	EFFC311	EFFC312	EFFC313	EFFC314	EFFC315	EFFC316	EFFC317	EFFC318	EFFC319	EFFC320	EFFC321	EFFC322	EFFC323	EFFC324	EFFC325	EFFC326	EFFC327	EFFC328	EFFC329	EFFC330	EFFC331	EFFC332	EFFC333	EFFC334	EFFC335	EFFC336	EFFC337	EFFC338	EFFC339	EFFC340	EFFC341	EFFC342	EFFC343	EFFC344	EFFC345	EFFC346	EFFC347	EFFC348	EFFC349	EFFC350	EFFC351	EFFC352	EFFC353	EFFC354	EFFC355	EFFC356	EFFC357	EFFC358	EFFC359	EFFC360	EFFC361	EFFC362	EFFC363	EFFC364	EFFC365	EFFC366	EFFC367	EFFC368	EFFC369	EFFC370	EFFC371	EFFC372	EFFC373	EFFC374	EFFC375	EFFC376	EFFC377	EFFC378	EFFC379	EFFC380	EFFC381	EFFC382	EFFC383	EFFC384	EFFC385	EFFC386	EFFC387	EFFC388	EFFC389	EFFC390	EFFC391	EFFC392	EFFC393	EFFC394	EFFC395	EFFC396	EFFC397	EFFC398	EFFC399	EFFC400	EFFC401	EFFC402	EFFC403	EFFC404	EFFC405	EFFC406	EFFC407	EFFC408	EFFC409	EFFC410	EFFC411	EFFC412	EFFC413	EFFC414	EFFC415	EFFC416	EFFC417	EFFC418	EFFC419	EFFC420	EFFC421	EFFC422	EFFC423	EFFC424	EFFC425	EFFC426	EFFC427	EFFC428	EFFC429	EFFC430	EFFC431	EFFC432	EFFC433	EFFC434	EFFC435	EFFC436	EFFC437	EFFC438	EFFC439	EFFC440	EFFC441	EFFC442	EFFC443	EFFC444	EFFC445	EFFC446	EFFC447	EFFC448	EFFC449	EFFC450	EFFC451	EFFC452	EFFC453	EFFC454	EFFC455	EFFC456	EFFC457	EFFC458	EFFC459	EFFC460	EFFC461	EFFC462	EFFC463	EFFC464	EFFC465	EFFC466	EFFC467	EFFC468	EFFC469	EFFC470	EFFC471	EFFC472	EFFC473	EFFC474	EFFC475	EFFC476	EFFC477	EFFC478	EFFC479	EFFC480	EFFC481	EFFC482	EFFC483	EFFC484	EFFC485	EFFC486	EFFC487	EFFC488	EFFC489	EFFC490	EFFC491	EFFC492	EFFC493	EFFC494	EFFC495	EFFC496	EFFC497	EFFC498	EFFC499	EFFC500	EFFC501	EFFC502	EFFC503	EFFC504	EFFC505	EFFC506	EFFC507	EFFC508	EFFC509	EFFC510	EFFC511	EFFC512	EFFC513	EFFC514	EFFC515	EFFC516	EFFC517	EFFC518	EFFC519	EFFC520	EFFC521	EFFC522	EFFC523	EFFC524	EFFC525	EFFC526	EFFC527	EFFC528	EFFC529	EFFC530	EFFC531	EFFC532	EFFC533	EFFC534	EFFC535	EFFC536	EFFC537	EFFC538	EFFC539	EFFC540	EFFC541	EFFC542	EFFC543	EFFC544	EFFC545	EFFC546	EFFC547	EFFC548	EFFC549	EFFC550	EFFC551	EFFC552	EFFC553	EFFC554	EFFC555	EFFC556	EFFC557	EFFC558	EFFC559	EFFC560	EFFC561	EFFC562	EFFC563	EFFC564	EFFC565	EFFC566	EFFC567	EFFC568	EFFC569	EFFC570	EFFC571	EFFC572	EFFC573	EFFC574	EFFC575	EFFC576	EFFC577	EFFC578	EFFC579	EFFC580	EFFC581	EFFC582	EFFC583	EFFC584	EFFC585	EFFC586	EFFC587	EFFC588	EFFC589	EFFC590	EFFC591	EFFC592	EFFC593	EFFC594	EFFC595	EFFC596	EFFC597	EFFC598	EFFC599	EFFC600	EFFC601	EFFC602	EFFC603	EFFC604	EFFC605	EFFC606	EFFC607	EFFC608	EFFC609	EFFC610	EFFC611	EFFC612	EFFC613	EFFC614	EFFC615	EFFC616	EFFC617	EFFC618	EFFC619	EFFC620	EFFC621	EFFC622	EFFC623	EFFC624	EFFC625	EFFC626	EFFC627	EFFC628	EFFC629	EFFC630	EFFC631	EFFC632	EFFC633	EFFC634	EFFC635	EFFC636	EFFC637	EFFC638	EFFC639	EFFC640	EFFC641	EFFC642	EFFC643	EFFC644	EFFC645	EFFC646	EFFC647	EFFC648	EFFC649	EFFC650	EFFC651	EFFC652	EFFC653	EFFC654	EFFC655	EFFC656	EFFC657	EFFC658	EFFC659	EFFC660	EFFC661	EFFC662	EFFC663	EFFC664	EFFC665	EFFC666	EFFC667	EFFC668	EFFC669	EFFC670	EFFC671	EFFC672	EFFC673	EFFC674	EFFC675	EFFC676	EFFC677	EFFC678	EFFC679	EFFC680	EFFC681	EFFC682	EFFC683	EFFC684	EFFC685	EFFC686	EFFC687	EFFC688	EFFC689	EFFC690	EFFC691	EFFC692	EFFC693	EFFC694	EFFC695	EFFC696	EFFC697	EFFC698	EFFC699	EFFC700	EFFC701	EFFC702	EFFC703	EFFC704	EFFC705	EFFC706	EFFC707	EFFC708	EFFC709	EFFC710	EFFC711	EFFC712	EFFC713	EFFC714	EFFC715	EFFC716	EFFC717	EFFC718	EFFC719	EFFC720	EFFC721	EFFC722	EFFC723	EFFC724	EFFC725	EFFC726	EFFC727	EFFC728	EFFC729	EFFC730	EFFC731	EFFC732	EFFC733	EFFC734	EFFC735	EFFC736	EFFC737	EFFC738	EFFC739	EFFC740	EFFC741	EFFC742	EFFC743	EFFC744	EFFC745	EFFC746	EFFC747	EFFC748	EFFC749	EFFC750	EFFC751	EFFC752	EFFC753	EFFC754	EFFC755	EFFC756	EFFC757	EFFC758	EFFC759	EFFC760	EFFC761	EFFC762	EFFC763	EFFC764	EFFC765	EFFC766	EFFC767	EFFC768	EFFC769	EFFC770	EFFC771	EFFC772	EFFC773	EFFC774	EFFC775	EFFC776	EFFC777	EFFC778	EFFC779	EFFC780	EFFC781	EFFC782	EFFC783	EFFC784	EFFC785	EFFC786	EFFC787	EFFC788	EFFC789	EFFC790	EFFC791	EFFC792	EFFC793	EFFC794	EFFC795	EFFC796	EFFC797	EFFC798	EFFC799	EFFC800	EFFC801	EFFC802	EFFC803	EFFC804	EFFC805	EFFC806	EFFC807	EFFC808	EFFC809	EFFC810	EFFC811	EFFC812	EFFC813	EFFC814	EFFC815	EFFC816	EFFC817	EFFC818	EFFC819	EFFC820	EFFC821	EFFC822	EFFC823	EFFC824	EFFC825	EFFC826	EFFC827	EFFC828	EFFC829	EFFC830	EFFC831	EFFC832	EFFC833	EFFC834	EFFC835	EFFC836	EFFC837	EFFC838	EFFC839	EFFC840	EFFC841	EFFC842	EFFC843	EFFC844	EFFC845	EFFC846	EFFC847	EFFC848	EFFC849	EFFC850	EFFC851	EFFC852	EFFC853	EFFC854	EFFC855	EFFC856	EFFC857	EFFC858	EFFC859	EFFC860	EFFC861	EFFC862	EFFC863	EFFC864	EFFC865	EFFC866	EFFC867	EFFC868	EFFC869	EFFC870	EFFC871	EFFC872	EFFC873	EFFC874	EFFC875	EFFC876	EFFC877	EFFC878	EFFC879	EFFC880	EFFC881	EFFC882	EFFC883	EFFC884	EFFC885	EFFC886	EFFC887	EFFC888	EFFC889	EFFC890	EFFC891	EFFC892	EFFC893	EFFC894	EFFC895	EFFC896	EFFC897	EFFC898	EFFC899	EFFC900	EFFC901	EFFC902	EFFC903	EFFC904	EFFC905	EFFC906	EFFC907	EFFC908	EFFC909	EFFC910	EFFC911	EFFC912	EFFC913	EFFC914	EFFC915	EFFC916	EFFC917	EFFC918	EFFC919	EFFC920	EFFC921	EFFC922	EFFC923	EFFC924	EFFC925	EFFC926	EFFC927	EFFC928	EFFC929	EFFC930	EFFC931	EFFC932	EFFC933	EFFC934	EFFC935	EFFC936	EFFC937	EFFC938	EFFC939	EFFC940	EFFC941	EFFC942	EFFC943	EFFC944	EFFC945	EFFC946	EFFC947	EFFC948	EFFC949	EFFC950	EFFC951	EFFC952	EFFC953	EFFC954	EFFC955	EFFC956	EFFC957	EFFC958	EFFC959	EFFC960	EFFC961	EFFC962	EFFC963	EFFC964	EFFC965	EFFC966	EFFC967	EFFC968	EFFC969	EFFC970	EFFC971	EFFC972	EFFC973	EFFC974	EFFC975	EFFC976	EFFC977	EFFC978	EFFC979	EFFC980	EFFC981	EFFC982	EFFC983	EFFC984	EFFC985	EFFC986	EFFC987	EFFC988	EFFC989	EFFC990	EFFC991	EFFC992	EFFC993	EFFC994	EFFC995	EFFC996	EFFC997	EFFC998	EFFC999	EFFC1000
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**PAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLANT-RATIO ECONOMIC COMPUTATIONS**  
**FLOWS IN CUBIC FEET PER SECOND (Cubic METERS PER SECOND)**  
**AREA IN SQUARE MILES (KILOMETERS<sup>2</sup>)**

## SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLUM	INITIAL VALUE IF 100% ON 100% 0%	SPILLWAY CREST 105.90 106.00 106.00 0.	TOP OF DAM 199.20 207.77 77.77			
RATIO OF PWF TO PWF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLUM CFG	DURATION OVER TOP HOURS	TIME OF MAX OUTFLUM HOURS	TIME OF FAILURE HOURS
.10	398.25	0.	167.	148.	0.	40.83	0.
.15	398.45	0.	199.	616.	0.	40.67	0.
.18	399.17	0.	206.	756.	0.	40.67	0.
.20	399.34	.14	210.	817.	0.	40.67	0.
.25	399.64	.04	217.	124.	1.33	40.50	0.
.30	399.80	.64	221.	1516.	1.61	40.50	0.
.35	400.01	.61	225.	1793.	2.33	40.50	0.
.50	400.42	1.22	230.	2635.	4.33	40.50	0.
1.00	401.38	2.16	257.	5192.	6.17	40.50	0.



PHOTO 1: Overview of Lake and Dam



PHOTO 2: Overview of Lake



PHOTO 3: Crest of Dam



PHOTO 4: Trees on Upstream Slope



PHOTO 5: Wavewash on Upstream Slope



PHOTO 6: Erosion on Downstream Edge of Crown



PHOTO 7: Downstream Slope



PHOTO 8: Erosion on Downstream Slope



PHOTO 9: Wash Area Near Right Abutment

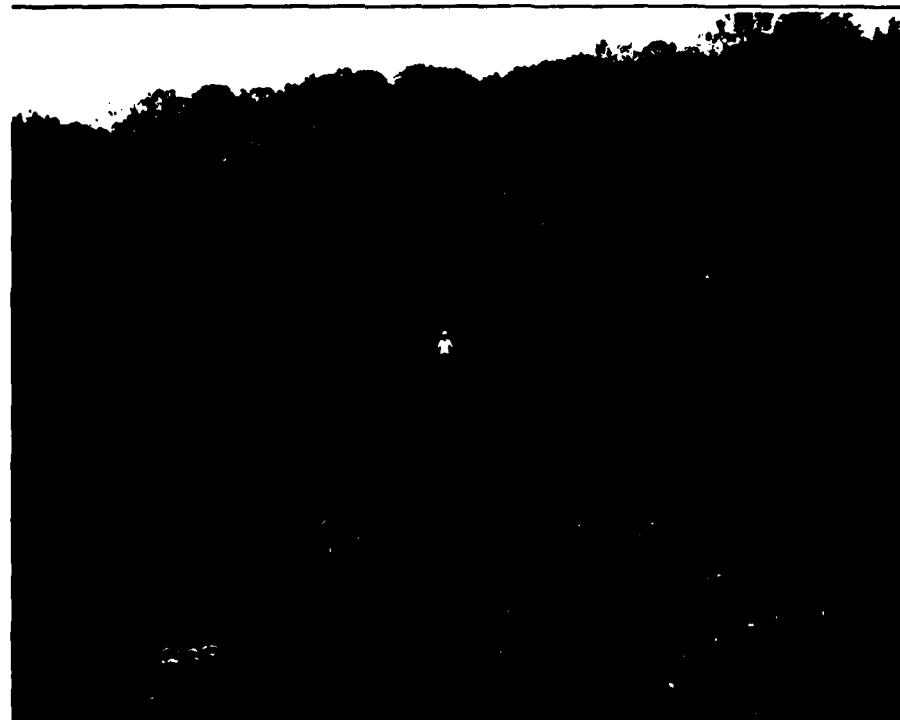


PHOTO 10: Saturated Area Near Downstream Toe



PHOTO 11: Saturated Area Near Downstream Toe



PHOTO 12: Seepage at Downstream Toe



PHOTO 13: Seepage at Downstream Toe



PHOTO 14: Spillway at Right Abutment - Upstream View

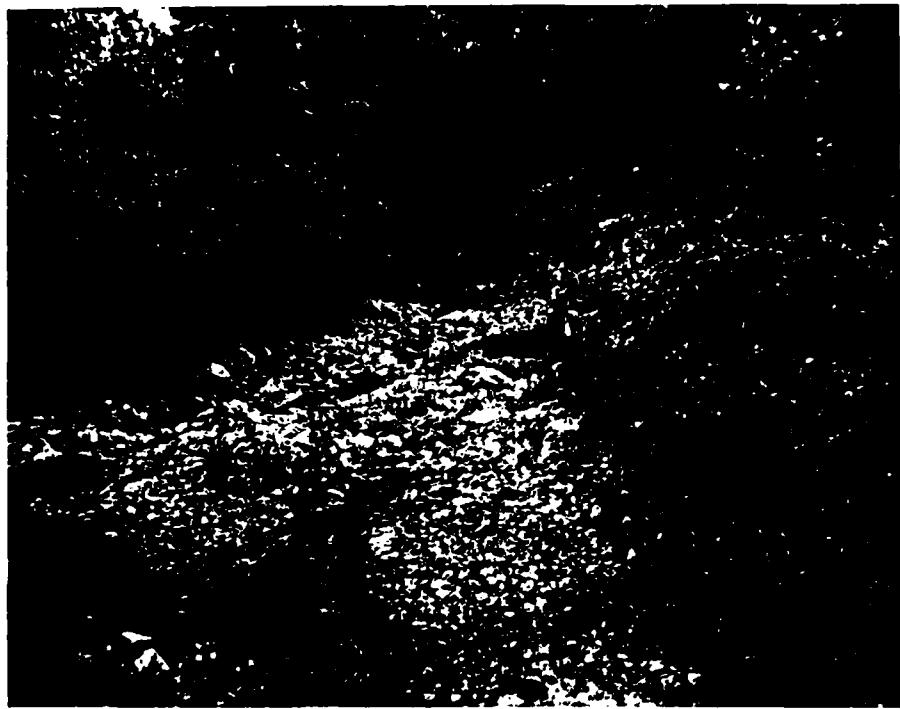


PHOTO 15: Spillway at Right Abutment - Downstream View



PHOTO 16: Spillway at Left Abutment - Side View



PHOTO 17: Spillway at Left Abutment - Downstream View

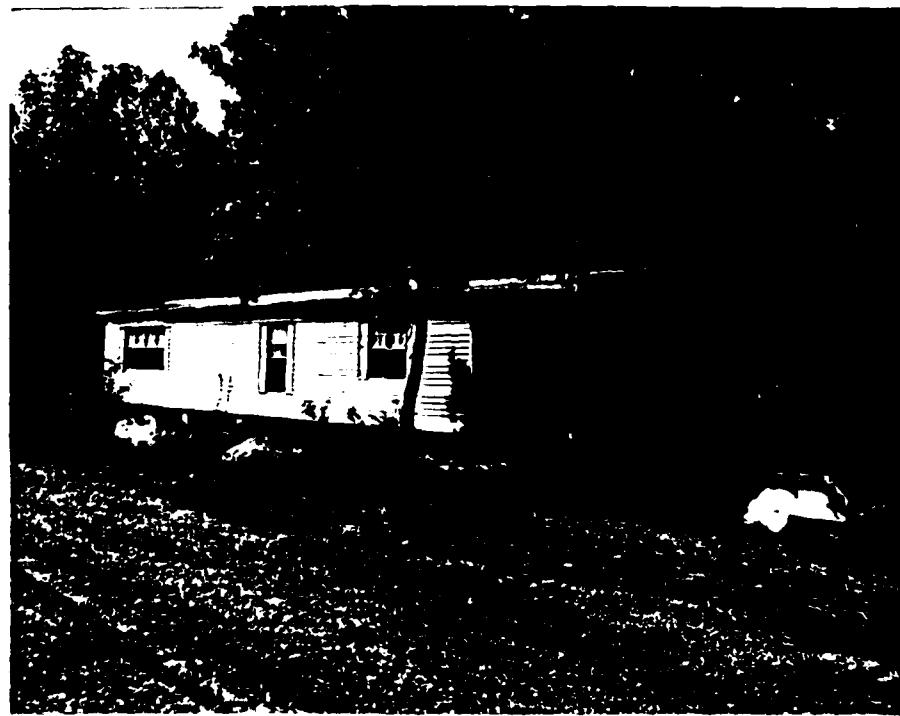


PHOTO 18: Typical Dwelling Downstream of Dam

## Brookfield City Dam

- Photo 1. - View of the upstream slope of the embankment.
- Photo 2. - View of the crest.
- Photo 3. - View of the downstream slope of the embankment.
- Photo 4. - View of cracks on the crest.
- Photo 5. - View of the riprap (dumped concrete) and the scarp above the riprap on the upstream slope.
- Photo 6. - View of seepage (standing water) at the downstream toe of the dam.
- Photo 7. - View of the spillway discharge channel looking downstream.
- Photo 8. - View of the control section and the trashrack of the spillway.
- Photo 9. - View of the discharge channel looking upstream.
- Photo 10. - View of tilted retaining wall in the discharge channel.
- Photo 11. - View of the energy dissipators at the end of the discharge channel.
- Photo 12. - View of one of the pumps in the pumphouse.
- Photo 13. - View of the downstream channel.
- Photo 14. - View of the reservoir rim.